A letter was read from Dr. Emin Pasha, C.M.Z.S., dated Bussisi (on Lake Victoria Nyanza), October 6, 1890, announcing the despatch to the Society of a collection of Birds which he had made on his way up from the coast.

The Secretary exhibited, on behalf of Mr. J. W. Willis-Bund, F.Z.S., a specimen of the Collared Petrel (*Œstrelata torquata*, Macg.), which had been shot off the Welsh coast in Cardigan Bay in December 1889, as recorded in the 'Zoologist' for 1890 (p. 454).

This was the first instance of the occurrence of this South-Pacific species in the British seas.

The following papers were read:—

1. On the Question of Saurognathism of the Pici, and other Osteological Notes upon that Group. By R. W. Shufeldt, C.M.Z.S. &c.

[Received January 9, 1891.]

For a number of years past the doubt has been growing in my mind as to the correctness of the interpretation placed upon the osseous structures at the base of the skull in the *Pici* by three morphologists who are the upholders of the idea of a state of saurognathism in these birds. This doubt has been strengthened during these years by many studies of the anatomy of Woodpeckers in all stages of growth and of many species. Within the past year the osteology of all the United States genera of this group in numerous cases, including skeletons of adults, subadults, and nestlings, has been carefully reviewed by me upon ample material. This last investigation has confirmed my doubts.

Of all those ornithotomists of authority who have made researches in this direction, the opinions of but three shall be adverted to here, and references will be made to Huxley, Parker, and Garrod.

No blame is attached to that host of most capable systematic ornithologists who, never having dissected a Woodpecker in their lives, have in their published works more or less blindly adopted the views of those who have relegated the *Pici* to a saurognathous group created to contain them. As is well-known, among the more recent interpreters of the structures exemplified on the part of birds, Professor Huxley, in his remarkable paper which appeared in the Proceedings of this Society for 1867 on the Classification of Birds, presented the results of some of his studies of the cranial peculiarities seen among the Woodpeckers. And so impressed was he with the apparently unique condition of certain osseous structures seen at the

cranial base in these forms, that he suggested a separate group for the *Pici*, viz. the *Celeomorphæ*.

But in characterizing this group, he was, from an insufficient supply of material, led into several errors,—errors of omission and errors of commission,—which have since been appreciated by the avian morphologist. Professor Huxley held that in the Woodpeckers "the vomers are very delicate rod-like bones, which in some cases, at any rate, remain permanently separate." It will be observed that he makes no reference to that median bone which is seen to lie between the palatines in some species, and which Parker afterwards designated as the "medio-palatine."

It would be superfluous for me to enter upon the question here of the enormous, and upon the whole beneficial, influence this masterly and opportune memoir has had upon the study of avian structure and taxonomy.

Later on Professor Garrod called into question the conception of these parts as arrived at by Professor Huxley[1].

Garrod remarked that "Professor Huxley, in his paper 'On the Classification of Birds,' has entered into considerable detail respecting the Woodpecker's palate, and from not finding a vomer present, and observing the peculiar longitudinal bony spicula connected with the inner edges of the palatine bones, opposite to and behind the fenestræ they assist to enclose, is led to think that these spicula are the rudiments of the vomer, which has not ossified across the middle line. But in carefully prepared skulls they look much more like the inner edges of the imperfectly ossified palatines, as they are connected completely with them at both ends. Further, in most of the specimens of *Gecinus viridis* and its allies that I have had the opportunity of examining, I have found a median bone, situated between the palatines, and supported like a vomer on the basisphenoid rostrum, at the anterior end of its broader portion. This bone is small, and shaped very much like a spear-head with the tip directed forwards, whilst posteriorly it gradually becomes fibrous and tends to bifurcate, but not in the ossified part. It does not extend backwards quite so far as the pterygo-palatine articulation."

It is evident that Garrod saw the *vomer* of the *Pici* in the median bone which Professor Huxley had overlooked, and construed the spicula given off by the palatine bones, *not* as vomers, but as palatine spurs of processes.

Next appears the beautiful monograph of Professor W. Kitchen Parker, entitled "On the Morphology of the Skull in the Woodpeckers (Picidæ) and Wrynecks (Yungidæ)," which was read before the Linnean Society of London in April 1874. It is illustrated by five superb 4to plates coloured, giving enlarged views of the skulls of several Woodpeckers, *Iynx*, &c. In this work Professor Parker essentially adopted the views of Huxley in the premisses and amplified them. The saurognathism of the *Pici*, however, evidently still had its doubters and opponents, for in the work just quoted Professor Parker

[1] Garrod, A. W., "Note on some of the Cranial Peculiarities of the Woodpeckers," Ibis, 1872, pp. 357–60, October 1.

is constrained to say that, "Thus in the large series of types which I have determined to compare together, it has seemed fit to me to take a very small territory; yet that territory contains parts that have undergone the greatest amount of metamorphosis of any in the whole body of a high and noble vertebrate, and moreover being, in the bird, the skeletal framework of the whole upper face, these parts are, as it were, an index of the amount of specialization undergone by any particular type—the ruling determining structures that lead to all, and really demand all, the changes that take place in the rest of the organism. This is especially explained for the benefit of those who will accuse me, and have already accused Professor Huxley, of taking a narrow view of the Bird-types—touching with the point of a needle some little tract, but unacquainted with and not able to appreciate the Bird as a *whole*."

After long thought and, as stated above, after many dissections of Woodpeckers of various genera, the writer is led to believe in regard to this question that—(1) The Pici are peculiar in regard to certain osseous structures of the cranium, *but* inasmuch as *all* the rest of their organization exhibits a high order of specialization, nearly equalling some of the *highest* among *birds*, these few characters must not be considered as being the representatives of the corresponding parts, in structure and arrangement, as found among some Lizards. We have abundant evidence of the Reptilian origin of birds without damaging this evidence by straining such points as these.

(2) That inasmuch as the *vomer* in *all* adult birds, even in the Ostrich-types, is single and *median*, the "medio-palatine" of Parker must be considered the *vomer* of the *Pici*. And when other small, median ossifications are found along in the line of the vomer, when the latter is present, they are simply adventitious ossicles occurring in the soft, membranous medio-septa of these vertebrates; such structures are occasionally seen in certain Hawks and Owls.

(3) That the processes designated as the *vomers* of the *Pici* by Professor Parker are merely apophysial outgrowths of the mesial borders of the palatines, and as the palatines are paired bones in Aves, we cannot conceive of such a structure in them as a "medio-palatine."

(4) That they are not desmognathous means nothing in a saurian sense, for even among the so-called Desmognathæ, *Elanus* is a *non*-desmognathous bird; and that the "maxillo-palatines" are but little developed in the *Pici*, applies also with almost equal truth to the *Trochili*, where we find them much reduced.

(5) That the fact that the basipterygoid processes are arrested would not especially entitle them to be called a saurognathous group. We see the same in some *Accipitres*, and they are functional in the Owls and other highly organized birds.

(6) That we do not believe that the *pterygoid* of a Woodpecker in any way especially answers to that bone in a Snake or a Lizard, any more than does the pterygoid of any other highly specialized bird. And further, that some of the peculiarities of the *Pici* may be due to the fact that these birds have long used their bills to strike

heavily with, which in time may have come to modify certain structures of the cranium, as has been pointed out by Garrod [1].

(7) It is quite characteristic of many of the skulls in the *Pici* that some of the free margins of the cranial bones, during the growth of the species, are prone to ossify by what may be designated as a "ragged border," and this will account for the minute granular islets of bone which occur along the mesial margins of the palatines; they are the so-called "septo-maxillaries" of Parker,—but they really belong to the palatines. We have found them to *vary* greatly in *number*, and in *position* in the same species. They are likewise adventitious ossifications, and they belong to the same category as the "Wormian bones" of anthropotomy.

(8) Finally, as to the nasal labyrinth, we find nothing especially saurian beyond what we see in other highly specialized types of birds. Parker has said in the article "Birds" of the 'Encyclopædia Britannica' (9th ed. p. 717), that "these birds are saurognathous in other respects, *e. g.*, their nasal labyrinth is unusually simple. The 'inferior turbinal,' which has three coils in *Rhea* and *Tinamus*, and *two* in most birds, is in *Gecinus* merely bi-alate; in *Iynx* it makes less than a single turn, whilst the alinasal turbinal of that bird has two turns, and that of *Gecinus* one. *Gecinus* is in all respects the most specialized, *Picumnus* the most embryonic, and *Iynx* the most passerine of the *Celeomorphæ*. Also, in *Gecinus* the nasal labyrinth is most ossified, and in *Iynx* least."

This strikes us as rather peculiar logic when arguing for the saurian organization of certain cranial structures as seen in the *Pici*: especially when we come to recognize the relative position of *Rhea* in the system, and the high position held by the *Passeres*.

Indeed, we must believe that too close study of a single set of characters stands in danger of making us blind to the significance of the *tout ensemble* of the characters presented on the part of the entire economy of the form examined.

In his Linnean paper quoted above, Professor Parker says of *Picumnus minutus* that "I have had to work out the parts of this bird's palate from the fractured skull in a *dry skin*." His entire knowledge of the structures of this interesting genus of birds probably rested upon this examination. It is evident, then, what we most need now in this direction is a full description of the *entire* structure of several genera of the *Pici*, with the same for *Iynx* and *Picumnus*, and these thoroughly compared with several of the *Cotingidæ* and *Formicariidæ* and allied forms.

As I have already remarked on a foregoing page, I have recently examined series of skeletons of many species of Woodpeckers found in the United States. The results of these investigations have been written out to form one of the chapters of my work upon the Osteology of Birds of this country. Two sections terminate the chapter and they are herewith presented in advance of the publication for which they were written.

[1] Coll. Sci. Memoirs, p. 117.

Summary of the chief Osteological Characters of the North-American Pici.

1. Large, but simple-scrolled turbinals; there may be a free turbinal.

2. Bulging of the frontal region over the transverse cranio-facial line may (*Picoides*) or may not (*Colaptes*) exist.

3. Generally the external cranial vault is more or less dinted by the ends of the quills of the capital feathers.

4. The interorbital septum is sometimes entire and sometimes shows a fenestra.

5. Pars plana large, and often the *os uncinatum* is well-developed.

6. Lacrymal usually vestigial in character.

7. Quadrato-jugal aborted.

8. Tympanic bullæ cowrie-shell shaped, and otherwise peculiar.

9. A large spur on the upper side of either pterygoid for muscular attachment.

10. A median, dagger-shaped vomer sometimes present but sometimes absent.

11. Maxillo-palatines rounded, laminar and very much aborted.

12. A more or less imperfect nasal septum usually present.

13. Vestigial basipterygoid processes are distinctly developed in some species.

14. As ossification advances in the palatines it may be characterized as being "ragged" along the antero-mesial and antero-external margins of these bones. This often leaves little osseous islets not absorbed, a few of which may persist here and there throughout the life of the individual.

15. Either palatine is characterized by possessing an "interpalatine spine" or process, and this may be continued forwards to fuse with the mesial border of the bone by its free tip. Either palatine also possesses a *palatine spur*, springing from the anterior point of the internal lamina of the bone and being directed forwards. It may also in some species pass on to fuse with the mesial edge of the palatine to which it belongs by its free end. The postero-external angle of a palatine is either truncated or shows various degrees of being bluntly rounded.

16. The mesopterygoid process of a pterygoid is not paddle-shaped, but long and narrowly pointed.

17. Distinct orbito-sphenoids exist in the nestling.

18. Mandible very strong, typically V-shaped in pattern; sides deep; symphysis varies in depth; ramal vacuity absent, or minute if present, and never large. Posterior angular processes more or less truncated; internal angular processes large. In some species the posterior third of the inferior ramal border somewhat tumefied and roughened.

19. Rudimentary cerato-hyals which early fuse together.

20. Uro-hyal absent.

21. Elongated thyro-hyal elements curl up over the cranium to a greater or less extent. They may pass round the right orbit.

They may come to the posterior margin of the right external narial aperture. They may hardly come up on the cranium at all. Whenever they do, the cranium is usually externally furrowed to receive them.

22. Sclerotal plates of the eye commonly fuse completely together around their external periphery and towards the centre.

23. "Double 'infrastapedial' and ossified stylohyal" (Parker).

24. Rings, semirings, and other parts of the trachea ossify.

25. There are 19 free vertebræ between the skull and pelvis: the vertebrarterial canals pierce the atlas, and in some species the axis; the atlantal cup is perforate; there are no parial parapophyses; the carotid canal may or may not be entirely closed in by bone; where they are present the neural and hæmal spines are usually very large. There are three pairs of cervical ribs, five pairs of dorsal ribs, and one pair of sacral ribs. The hæmapophyses of the latter do not reach the sternum. In some species the first pair of costal ribs are very robust, as are the last pair of cervical ones. There are five or usually six tail-vertebræ (free), with an enormous pygostyle. Most of these parts are highly pneumatic.

26. The sternum is 2-notched on either side of the carina; the manubrium is either slightly or very much bifurcated; the costal processes are long and pointed, and the keel is usually rather shallow, projecting forwards and carried up under the manubrial process. The sternum is usually completely pneumatic.

27. In the pelvis we find the ilia gradually diverging from the sacral crista as they pass forwards. Parial interdiapophysial foramina are either very minute or entirely absent. Ischial notch on the posterior margin of the bone long, rounded, and shallow. Acetabulæ large, and bases completely absorbed. Sides of pelvis usually very deep. Postpubis slender, extends beyond ischium, the foot of which latter may or may not fuse with it. Obturator space large, and may or may not merge with the obturator foramen. *Three* of the vertebræ of the sacrum anteriorly throw out their processes against the ventral iliac walls. The pleurapophysial and transverse processes of the sacral vertebræ opposite the acetabulæ are not modified and lengthened so as to act as braces at the points in question. The pelvis is commonly completely pneumatic.

28. Bones of the shoulder-girdle pneumatic, with the exception (sometimes) of the furcula. This latter is of the U-shaped pattern, without hypocleidium, large, flat scapulo-coracoid ends (which originate from separate ossific centres in the young), and with laterally compressed limbs. Posterior end of scapula more or less modified to be bent or to curl outwards, giving the bone a very unique form. Coracoids long, not very stout, and with the anterior end more or less laterally compressed.

29. An *os humero-scapulare* present at either shoulder-joint; functional, and has much the same shape as the ossicle has in the *Passeres*.

30. Either the humerus alone, or it together with the long bones of the antibrachium, may be pneumatic. A small sesamoid is found at

the elbow. Seven prominent osseous papillæ occur at nearly equal distances apart down the shaft of the ulna. The flat, rounded process from the postero-upper third of the shaft of index metacarpal is present. The slender last metacarpal extends below the one of index, and its free digital joint is *larger* than either of the other terminal phalanges. The proximal phalanx of index digit has its posterior blade almost entirely aborted. There are no claws.

31. Femur is always pneumatic, and so may be the tibio-tarsus in some species. In the former the trochanter major does not rise above the summit of the shaft; the excavation on the head is very shallow. Shaft nearly straight; condyles rather small; popliteal fossa and rotular channe very shallow. *Pici* possess patellæ. Cnemial crest of tibio-tarsus elevated above summit of bone, with pro- and ecto-cnemial ridges nearly or quite aborted. Condyles of this bone very distinct, and intercondyloid valley very deep. Bony bridgelet confines tendons in front. Fibula short and free, its lower spicula-like end being held well away from shaft of tibio-tarsus by the increasing height of fibular ridge on the latter bone.

Hypotarsus of tarso-metatarsus both grooved and perforated for passage of tendons. An erect process occurs on the summit of this bone of the leg. Its shaft is nearly straight, and its terminal trochleæ are specially modified to meet the podal requirements of the picine zygodactyle foot.

Joints of pes normal, 2, 3, 4, and 5 to the first, second, third, and fourth toes respectively. Fourth toe permanently reversed, and first toe, together with its free metatarsal bone, may be entirely absent (*Picoides*). A larger sesamoid articulates with a special trochlea (intended for it) to the inner side of the fourth toe. The osseous claws usually large, and the other phalangeal joints more or less laterally compressed. The tendons of the leg sometimes ossify to a certain degree, and minute sesamoids may occur in certain tendons near the knee-joint.

Brief Remarks on the probable position of the Pici *in the System, and on their Affines.*

Huxley in his "Celeomorphæ" comprehended only the *Picidæ* and *Iyngidæ*, and Parker long ago said that "the 'Celeomorphæ' of Huxley form a most natural and well-defined group—a group equal, zoologically, to the Pigeons or the Parrots. Evidently this differentiation has taken place through the gradual extinction, during long secular periods, of conjugational types more generalized than those now extant." In this much the present writer agrees with the two great authorities we have just quoted.

To those at all familiar with the osteology of existing birds it must be very evident that in an anatomical system, at least, the *Pici* hold many characters in common with the *Passeres*, a fact that will be evident when we come to treat of that group later on. It is my opinion that it is to the great Passerine group that the *Pici* are more